The Boy, the Kite and the 100 Square Mile Real-Time Digital Backlot

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Abstract

To make a short animated film in a brief period of time is in itself a challenge. To make a short animated piece using tech you haven't developed and assets you haven't created for a unmovable deadline is beyond terrifying. While we had a general plan in place as well as an approved design for our main character as well as photographs we planned to process into our world assets we had nothing else. On the 5th of January we came back to work after our Christmas break and embarked on what was one of the most challenging 57 days of our professional careers.

1 World Building

We mixed NASA SRTM elevation data with hand crafted shapes to generate our base landscape. To aid in populating our 256sq km world we added Procedural Foliage tools to propagate the spreading of foliage. The Procedural Foliage system interfaces with Hand-Painted foliage system making it possible to mix hand crafted areas for important cinematic shots.

Assets were primarily Photomodelled. Foliage was hand crafted from photo source and a Photomodelled bark. Trees had continuous LOD baked per branch.l New Landscape-Grass tools allowed Material-Driven grass placement in the world which means placement and coloration of ground cover can be controlled via a combination of hand painted or any material instructions.

2 Asset Creation

The massive world size was the most challenging aspect from the rendering point of view. We relied heavily on instancing and hierarchical clustering for making culling, LOD, and submission to the GPU efficient. Grass proved to be too numerous to store on disk so it was procedurally generated on the fly using painted masks.

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The size in addition to dynamic time of day meant that we weren't able to reasonably precompute the lighting. Sunlight was calculated as a directional light source with cascaded shadow maps in the foreground. In the distance the number of objects made cascades extremely expensive. Instead we used ray tracing of per object signed distance fields which was both a quality and performance improvement. Signed distance fields were also cone traced in a hemisphere to calculate sky shadowing. This is effectively large scale ambient occlusion. Indirect lighting was bounced from the terrain using a simplified PBGI method that is height map specific.

Besides scale we also worked on improving our camera model to be more physically based. This involved developing new "scatter as you gather" based depth of field and motion blur algorithms, matching our bloom, vignetting, and chromatic aberration to captured reference, and finally adopting the Academy Color Encoding System (ACES) as a replacement for our previous tone mapper.

3 Shooting the Cinematic

‘A Boy and his Kite’ was treated from a cinematic perspective as a CG short but one which had been designed primarily to show off landscapes and vistas as well as extreme closeups of some of our photogrammetry assets. We had decided on six primary locations with the locations becoming more and more rugged as the boys journey continued. The only location that wasn’t based off of the height-map was the cave at the end of the piece which was conceived solely for the cinematic. While we have shied away from complex facial rigs or facial performances in the past, with this demo we wanted to have a character giving a believable performance to camera with no obstructions or cutaways to avoid complexity. The technical challenges of real-time graphics made some universally accepted cinematic language choices unavailable to us and other solutions had to be found.